Melbourne:—Flagstaff Observatory. Meteorological Observations, 1857–58. 2 vols. sm. fol. Daily Meteorological Register, 1859–1863. 5 vols. fol. Original Observations on Atmospheric Electricity, 1858. sm. fol. Daily Electrical Register, 1860–63. 3 vols. 4to. Magnetical Observations, 1st May to 31st Dec. 1858. sm. fol. Remarks and Disturbance Observations during the year 1859. Daily Magnetical Register, 1860–62, and Jan. to Feb. 1863. 3 vols. sm. fol. MSS. Presented by the Observer, Dr. Neumayer.

The following communications were read:—

I. "Observations on the Temperature of the Strata taken during the sinking of the Rose Bridge Colliery, Wigan, Lancashire, 1868–69." By Edward Hull, M.A., F.R.S., Director of the Geological Survey of Ireland. Received November 27, 1869.

In an elaborate paper by Mr. W. Hopkins, F.R.S., entitled "Experimental Researches on the Conductive Powers of various Substances," published in the Philosophical Transactions for 1857, an account is given of a series of experiments made under the general supervision of Mr. Hopkins himself and Mr. W. Fairbairn, F.R.S., during the sinking of the Astley Pit of Dukenfield Colliery in Cheshire*. At the time this paper was written the depth attained was only a little more than 1400 feet; and the rate of increase between the depths of 700 feet and 1330 feet was found to be 1° F. for about 65 feet. These observations were subsequently continued until the pits had attained their full depth of 717 yards from the surface. The last observation made was in the shale overlying the coal-seam, known as the "Black Mine," which it was the object of the proprietor, Mr. Astley, to reach, and the temperature was found to be 75° F. Assuming the "stratum of constant temperature," or, as it is also called by Humboldt, "the invariable stratum," to be that which was reached at 16·5 feet with a temperature of 51° F., the total increase of temperature would amount to 24° F., giving as the rate of increase 1° F. for every 88·925 feet. This is much below the average rate of increase.

During a part of the period above referred to (from 1854–56) another coal-pit was being sunk at Wigan, which reached the depth of 600 yards, down to the celebrated "Cannel Mine." At this pit similar observations on the temperature of the strata were made very carefully by the manager, Mr. Bryham, which were kindly communicated to myself for publication, and will be found in my work on the 'Coalfields of Great Britain.' The ultimate temperature attained in this pit at the depth from the surface of 600 yards was found to be 72° F.; and assuming the invariable stratum to be the same as that at Dukenfield Colliery, the resulting rate of increase would be 1° F. for every 61·5 feet, which accords very closely with the

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* The entire series of these interesting observations were kindly supplied to me by Mr. W. Fairbairn, and are published in 'The Coalfields of Great Britain,' 2nd edit. p. 226.

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result obtained by Professor Phillips, F.R.S., at the Monkwearmouth Colliery.

Since the time above referred to, the proprietor of the Rose Bridge Colliery, Mr. J. Grant Morris, determined to carry down the shafts from the "Cannel" seam to the "Arley" seam of coal, which was known to lie more than 200 yards below it; and consequently in the spring of 1868 preparations were commenced for carrying out this project. In the incredibly short time of one year and two months the Arley coal was struck, and was found to be of good thickness and quality. The total depth reached was 808 yards, and the ultimate temperature in the coal itself was found to be 93½° F. The manager of the colliery, Mr. Bryham, sensible of the value of observations on the temperature of the strata at such unusual depths (this being probably the deepest colliery in the world, certainly in Britain), made a series of observations with as much care as the circumstances would admit, and has entrusted them to me for publication.

The mode of taking the observations was as follows:—On a favourable stratum, such as shale, or even coal, having been reached, a hole was drilled with water in the solid strata to a depth of one yard from the bottom of the pit. A thermometer was then inserted, the hole having been sealed and made airtight with clay. At the expiration of half an hour the thermometer was taken up and the reading noted.

It might possibly be objected that the time allowed (thirty minutes) was insufficient for the imbedding of the thermometer, and that the readings are liable to error from this cause. I feel sure, however, that if any error has arisen it is inappreciable, and does not in the least invalidate the general result. In fact I am assured by Mr. Bryham that, from actual testing on several occasions, he found less than this time of thirty minutes sufficient for the purpose required.

While the temperatures of the strata were being measured, observations were also carried on *pari passu* on those of the open pit during the descent. These are given in the Table annexed. By a comparison of the results in the two columns, it will be observed that as the depth increased the differences between the corresponding temperatures in the pit and the strata tended to augment; in other words, the temperature of the strata was found to augment more rapidly than that of the open pit.

The effects of the high temperature and pressure on the strata at the depth of 2425 feet are, as I am informed by Mr. Bryham, making themselves felt, and cause an increase in the expense both of labour and timber for props. This colliery, in fact, will be in a position to put to the test our views and speculations on the effects of high temperature and pressure on mining operations.

In order to obtain the average rate of increase of heat, as shown by the experiments at Rose Bridge Colliery, we may assume (in the absence of direct observation) the position and temperature of the *invariable stratum* to be 50 feet from the surface and 50° F., which is probably nearly the mean temperature of the place. With these data, the increase is 1° F. for every 54·57 feet, which approximates to that obtained by Professor Phillips at Monkwearmouth of 1° F. for about every 60 feet.

If, on the other hand, for the purpose of comparison, we adopt the measurements for the *invariable stratum* as obtained at Dukenfield, we find the rate of increase to be 1° F. for every 47·2 feet as against 1° F. for every 83·2 feet in the case of Dukenfield itself. So great a discordance in the results is remarkable, and is not, in my opinion, attributable to inaccuracy of observation in making the experiments. On the other hand, I may venture to suggest that it is due, at least in some measure, to dissimilarity in the position and inclination of the strata in each case. These I now proceed to point out.

Position of the Strata at Rose Bridge and Dukenfield Collieries.—Rose Bridge Colliery occupies a position in the centre of a gently sloping trough, where the beds are nearly horizontal; they are terminated both on the west and east by large parallel faults which throw up the strata on either side. The colliery is placed in what is known as "the deep belt."

Dukenfield Colliery, on the other hand, is planted upon strata which are highly inclined. The beds of sandstone, shale, and coal rise and crop out to the eastward at angles varying from 30° to 35°. Now I think we may assume that strata consisting of sandstones, shales, clays, and coal alternating with each other are capable of conducting heat more rapidly along the planes of bedding than across them, different kinds of rock having, as Mr. Hopkins's experiments show, different couducting-powers. If this be so, we have an evident reason for the dissimilar results in the two cases before us. Assuming a constant supply of heat from the interior of the earth, it could only escape, in the case of Rose Bridge, *across* the planes of bedding, meeting in its progress upwards the resistance offered by strata of, in each case, varying conducting-powers. On the other hand, in the case of Dukenfield the internal heat could travel along the steeply inclined strata themselves, and ultimately escape along the outcrop of the beds.

I merely offer this as a suggestion explanatory of the results before us, and may be allowed to add that the strata at Monkwearmouth Colliery, the thermometrical observations at which correspond so closely with those obtained at Rose Bridge, are also in a position not much removed from the horizontal, which is some evidence in corroboration of the views here offered.

Thermometrical Observations at Rose Bridge Colliery.

Date.	Depth, in yards.	Strata.	Temperature in open pit.	Temperature in solid strata.
			°F.	°F.
July 1854.	161	Blue shale	......	64·5
August 1854	188	Warrant earth	......	66
May 1858	550	Blue shale	......	78
July 1858	600	Warrant earth	......	80
May 18, 1868	630	"Raven" coal	73	83
July 24, 1868	665	Linn and wool	75	85
April 19, 1869.	673	"Yard Coal" mine	76	86
November 18, 1868.	700	Strong blue metal................	76	87
February 22, 1869...	736	Do.	76	$88\frac{1}{2}$
March 12, 1869	748	Shale	77	89
April 17, 1869	762	Linn and wool, or strong shale .	78	90·5
May 3, 1869	774	Strong shale	80	91·5
May 19, 1869.........	782	Blue metal...........................	79	92
July 8, 1869	801	Strong blue shale	79	93
July 16, 1869.........	808	Coal (Arley mine).................	79	$93\frac{1}{2}$

Remarks.

All holes vertical in solid at bottom of pit drilled with water 1 yard deep, and thermometer remained in hole thirty minutes and made airtight with clay.

II. "On the Action of Rays of high Refrangibility upon Gaseous Matter." By JOHN TYNDALL, LL.D., F.R.S., Professor of Natural Philosophy in the Royal Institution. Received December 4, 1869.

This paper is an expansion of the Researches already communicated to the Royal Society on the Chemical Action of Light on Gaseous Matter. (See Proceedings, vol. xvii. p. 92.)

III. "On the Theory of Continuous Beams." By JOHN MORTIMER HEPPEL, Mem. Inst. C.E. Communicated by Prof. W. J. MACQUORN RANKINE. Received December 9, 1869.

(Abstract.)

The chief object of the present communication is to remedy some acknowledged defects in the theory of the above-mentioned subject. The principal steps by which it has reached its present state of development are also noticed, and may be briefly recapitulated as follows :—

In 1825 M. Navier investigated the conditions of a straight continuous beam resting on any number of supports. His method, though perfectly correct for the assumed conditions (which embraced most cases occurring